KARRATHA

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

URBAN GEOLOGY OF THE KARRATHA SHEET

The aim of this urban geology survey is to provide information for those concerned with aspects of raw material and water supply, rural, urban, industrial or transport development. The intention is to point out geological factors which may affect planning on a broad, rather than specific basis. Detailed site investigations will still be required but it is hoped that this information will provide a useful framework for such further work.

The 718 km² covered by the Karratha sheet area contain two main land-uses: stock grazing over the majority of the area, and the Karratha light industrial area of some 2 km² in the north. The North West Coastal Highway and the Dampier-Tom Price railway cross the sheet area from west to east and north to south respectively.

The geology of the Dampier 1:250 000 sheet area, which includes Karratha, was mapped previously by Kriewaldt, Horwitz, Ryan and Bock of the Geological Survey of Western Australia, the results being published in 1964. This sheet was remapped in 1976 by Biggs of the Geological Survey, using 1:50 000 topographic base-maps and 1971 and 1972 air-photographs. The Precambrian rock subdivisions of the earlier mappers were utilized, with some modification from local evidence and from a regional study by Hickman. Additional text data were provided by relevant sections of the Geological Survey.

PHYSIOGRAPHY

The Karratha area is broadly divided into the physiographic units shown on the inset map. Four of the units occur within the sheet area. A small area of coastal flats in the northeast consists of mud and samphire flats submerged only during high Spring tides. The coastal plain is of generally low relief but includes broad river basins and gentle slopes on hill margins. The isolated hills division encompasses a variety of hilly landforms separated from the main hill massif to the south; rugged or rounded volcanic ranges, steep chert ridges and isolated erosional remnants (monadnocks) are included. The dissected uplands comprise the partly eroded edges of a plateau to the south, and include rolling or rugged hill massifs, in places deeply incised by narrow valleys.

STRATIGRAPHY

Rocks of Archaean and Proterozoic age crop out throughout the mapped area, thickly mantled in places by Tertiary and Quaternary sediments, especially in the southeastern. An active cycle of erosion and sedimentation is seen in the major river valleys, especially in the lower reaches. To a large extent, stratigraphy controls physiography, eroded granite and Quaternary sediments forming lowlands, the older rocks the uplands.

ARCHAEAN

The **undifferentiated metamorphosed intrusive complex** is probably derived from a suite of intrusive and some extrusive basic to intermediate rocks, all metamorphosed to various degrees. Subdivision at this scale is made impossible by the rapid variations in lithology, both horizontally and vertically. One major rock type is a medium-grained blue metabasalt; others include medium-grained amphibolite and quartzofeldspathic amphibolite, some sheared, some massive; amphibole schists; and medium-grained intermediate volcanic rocks. Minor quartz boudins and veins, and surficial calcrete development are widespread. Northwest of 8 Mile Well a 200 mm shear zone in metavolcanics is heavily impregnated with malachite, and traces of cuprous stainings occur elsewhere in this unit.

Intruding the metamorphic complex and underlying much of the plain is **granite and granite gneiss**. Although local variants are seen, most of the granite is an equigranular, coarse-grained, leucocratic or mesocratic, pink or grey rock, intensely sheared in places, especially in the southwest. Pods and veins of quartz-feldspar and quartz-feldspar-biotite pegmatite, and quartz are common. Some areas of grey granite are faintly or strongly gneissic. The granite is readily weathered to a medium to coarse, orange-brown quartz sand which is particularly well preserved east of Prinsep Well. A metre of laterite caps some granite outcrops.

As evidence for the invasive nature of at least part of the granite, a zone of **hybridised basic rocks** is recognized. A mesocratic blue-green, medium to coarse-grained contaminated granite containing rafts of siliceous amphibolite has hybridized the basic rocks to a coarse-grained quartzofeldspathic amphibolite. The green colour of the granite is caused by chlorite which is assumed to have been derived from the basic rocks.

Mamive and schistose amphibolites have been mapped in the north and west of the sheet area. They may simply be sheared horizons of the "*Av*" unit and therefore should be included in that unit but detailed stratigraphic data are not available. Lithologies include blue-green hornblende schist and amphibolite; blue-grey foliated or sheared amphibolite; white and grey, laminated or massive and saccharoidal, micaceous quartzite; and some massive blue-grey and blue-brown carbonated metabasic intrusive rocks. South of Edna Well, near the postulated location of the Sholl Shear Zone, the amphibolite is massive, cleaved and talcose. Malachite is scen impregnating amphibolites and some quartzite.

The **felsic volcanics** are medium-grained rhyodacites and similar rocks. Many are porphyritic with phenocrysts of quartz and plagioclase in a fine-grained matrix. Intercalated with these rocks are medium-grained silicerous amphibolite and coarse-grained amphibolite composed of randomly-orientated fibrous amphibole. There are also minor intercalations of blue cherts and siliceous shale and siltstone.

The felsic unit is a subdivision of the **basic and intermediate volcanics** division, which encompasses a wide variety of unaltered or metamorphosed volcanic rocks, pyroclastics and other sedimentary rocks. The predominant rock types are fine to coarse-grained, greenish or bluish grey metabasalts, metagabbros and spilites, widely showing pillow structures. Some relict textures may represent original flow-banding of lavas. Epidoritization of these rocks is widespread and epidote fills the vughs in one fine-grained amygdaloidal basalt. Hornblende rhyodacite and fine-grained quartz diorite have also been recognized in this division. Calcite veining is common, as is the development of calcrete or mammiform quartz on weathering surfaces.

Several of the igneous strata have undergone greater metamorphism and are now represented by greenish amphibolites, some cleaved, others massive, schistose or knotted. Random radiating and parallel arrangements of amphibole occur. Pencil-slates have developed in one area of cross-cleaving. Minor but important ultramafic horizons occur throughout the sequence, chiefly pyroxenite. Pyrite and, to a lesser extent, malachite are common accessory minerals. Probable former ash beds now occur as siliceous or quartzofeldspathic bands and there are several interbedded horizons of shale, chert, siltstone and dolomite. One occurrence of a suspected dolomite containing pyrite was seen in thin section to be a thoroughly carbonated, medium-grained amphibolite.

Stratigraphically within the above unit but distinct from it are **cherts and clastic sediments** with very minor metavolcanics, amphibolites and actinolite schist. The cherts, both massive and laminated, appear to predominate because they are resistant to weathering and form ridges of bare white, grey, brown, blue or black rock. One bright green chert north of Edna Well has been excavated as a semi-precious stone. Subordinate in outcrop but probably of greater total thickness than the cherts are mottled purple and brown, siliceous tuffs and blue-grey ashes; white, greenish and honey-coloured quartzites and green fuchsitic shales and cherts. Minor horizons include green grass; soft, black and dark green carbonaceous ?ash showing effects of penecontemporaneous slumping and sedimentary brecciation; quartzite with rare malachite; and brown dolomite with pyrite and rare chalcopyrite. Calcrete development and manganese staining are widespread, and fossil subaerial weathering has led to laterization in one locality.

The **ferruginous chert** unit is a marine sedimentary sequence, correlated with the Gorge Creek Group near Marble Bar. Black, brown and red ferruginous cherts distinguish this from the lower sedimentary sequence. Non-ferruginous cherts occur in shades of green, blue, grey and white, alternating with fawn shales. Other minor sediments seen are blue dolomitic siltstone, weathered volcaniclastics and pale brown or green sericitic saccharoidal quartzite. Rare thin horizons of foliated amphibolite probably represent brief periods of volcanicity. The hematite and chert horizons are thinly laminated except where iron has been removed by leaching and silica redeposited to form a massive chert, commonly manganese stained.

PROTEROZOIC

Quartz veins crop out conspicuously near the North West Coastal Highway and to a lesser extent elsewhere. The quartz is massive, crystalline and opaque, varying in colour from white to a greenish grey. The veins are monomineralic, pinch and swell to 40 m wide and, being resistant to weathering, form low or acute ridges with broad scree slopes. Local shearing produces a saccharoidal structure which allows iron oxides to penetrate and impart a pink colour to the quartz.

Gabbro and dolerite sills have intruded volcanic rocks at several localities. Similar in lithology to the basic volcanics, the sills have a more rugged weathering pattern and thinner soils. They range from coarse-grained, melanocratic, blue-grey gabbro to medium-grained, mesocratic, grey dolerite. Some porphyritic examples are seen with feldspar phenocrysts and pyrite is a common accessory. Northwest of Mount Sholl, the gabbro has a flat base above steeply-dipping Archaean metavolcanics and includes xenoliths of those rocks.

Mount Roe Basalt rests with angular unconformity on the felsic volcanics in the Mount Sholl range. Massive, amygdaloidal, scoriaceous and vesicular basaltic and andesitic lavas are intercalated with red siltstones, sandstones and tuffs. The lavas locally exhibit columnar jointing and weather to a blocky, mid-brown boulder scree.

The **granophyric xenolithic dyke** extends discontinuously across the mapped area from northwest to southeast. Commonly some 50 m wide, it is a medium-grained, pale grey rock of tremolite and chlorite after pyroxene, asumorittized plagioclase and quartz, the last two commonly graphically intergrown in a granophyric texture. In the groundmass are xenoliths of coarse-grained, leucocratic granite, quartz and plagioclase, all of which have undergone pyrometamorphism. The dyke is genetically related to the extensive Gidley Granophyre to the north.

Dolerite dykes cut all Precambrian rock-types and some are sufficiently resistant to stand proud of Quaternary sediments. The dolerite is medium to coarse-grained, melanocratic blue to grey and has dark brown, spheroidal weathering surfaces. Most dykes contain abundant disseminated pyrite and some are possibly feeders to the gabbros in the southeast and central east.

TERTIARY

Laterite occurs in small, widely-separated outcrops which are probably the remnants of an eroded wider cover. Most occurrences are of a hard, rubbly, pisolitic or massive, reddish-brown rock up to 3 m thick, but on Twin Table Hill a more complete profile is preserved. Beneath the hard cap is a softer, mottled brown and orange, earthy laterite above a white kaolinitic zone. A dolerite in the hill has been completely kaolinized. Some irregular laterite pebble surfaces and thin caps on basic volcanics are considered too small to show at this map scale.

QUATERNARY

Variants of the red-brown **silty sand** are seen throughout the mapped area and include transitional deposits between colluvium and alluvium. Partly eluvial and partly a flood-plain deposit, the unit shows rapid lateral variation within an overall uniformity, consisting mainly of subangular to subrounded, unsorted, fine to coarse quartz grains with varied proportions of fine, reddish-brown silt. Calcrete is often developed as nodules or a continuous stratum to one metre thick, usually a metre below surface. Pebbles of limonite or rock are ubiquitous, particularly where low outcrops of bedrock penetrate the sands. In some excavations the sand is seen to grade downwards into kaolinized granite. In areas where the clay and silt contents increase, small sinkholes develop and the unit grades into the "Qc" subdivision described below. High-level flood deposits which form levees in the Maitland River valley are included in this unit.

Eolian and clayey sands are derived from the "Qes" unit and comprise very fine to medium-grained, reddish-brown quartz sands with varied but generally high proportions of clays. Some of the clay minerals are assumed to be swelling clays, the expansion and contraction of which give rise to a characteristic sinkhole or "crabhole" topography. Perhaps reflecting the relative fineness of the grains, the prevailing easterly winds have winnowed the sand and created low, parallel NE dunes in the west and central portions of the mapped area. No distinct dune patterns occur in the east, probably as a result of a wind-shadow effect in the lee of hills. The unit is generally pebble free.

In contrast is the **outwash gravel veneer** which comprises a thin, almost continuous pebble pavement on the parent sandy silt. Rarely more than 5 cm thick, the veneer is thought to have been formed when gentle sheet-flooding removed all the finer fractions of clay and sand. Wind action may also contribute to the formation of the veneer as many of the pebbles are glazed. Many occurrences of the gravel cover only small areas and their total extent is possibly greater than shown on the map.

Colluvium has only been mapped where it is thick or forms a significant topographic feature. Many scattered areas of thin colluvial material occur on metasediments and volcanics and these are not shown on the map. The material is unsorted and ranges from fine clays through sands to angular pebbles and boulders of the parent rock. Quartz veins and cherts are commonly flanked by colluvium. Surrounding Twin Table Hill the colluvium is sandy and kaolinitic with fragments of laterite rubble.

Alluvium appears in all present-day drainage channels and is still being deposited. All grain sizes may be present in separate lenses, from very fine silt, especially in lower reaches, through fine to coarse sands, to pebble and boulder beds. Individual grains may be angular to rounded, depending on distance from source, the majority being subangular to subrounded. River and creek banks are usually of silt or fine sand. Sands are predominantly quartz but include rock fragments, feldspar and limonite and rare zircon, garnet and other heavy minerals.

The Holocene **silty sand** is in most respects identical with the Pleistocene unit but is distinguished by containing shells of the bivalve *Anadara granosa*. Shells of this and other molluscs are distributed throughout the sand and are widely scattered on the surface after erosion has removed the matrix. The unit is probably derived by reworking of the Pleistocene silty sand.

Mud and silt represent the most recent sedimentation and are being deposited on the ocean margin inland of fringing mangroves. Covered only by high Spring tides, the red and brown sediments may have a patchy surface veneer of salt crystals, modern shells and rock fragments.

STRUCTURE

The Archaean structural trend is northeasterly within a series of anticlines and synclines. One syncline, through Mount Marie and Roth Well is tightly folded and in places may be overturned. Minor and microfolding are common throughout Precambrian rocks. The Proterozoic gabbros and Mount Roe Basalt unconformably overlie the steeper-dipping Archaean rocks.

Faulting is widespread in the area but can only be depicted on this map where displacement of marker horizons occurs. It is probable that many of the dolerite dykes have exploited faults within the volcanic sequences. A major shear zone, the Sholl Shear Zone, bisects the sheet area from east to west. Intense shearing marks its location in the east but Quaternary sediments obscure much evidence in the west. The shear appears to have a considerable sinistral displacement, the full extent of which has not been measured.

ECONOMIC GEOLOGY

ASBESTOS

Veins of chrysotile in serpentinized peridotite have been tested 4 km north of Toocare Pool, but no production is recorded.

CONSTRUCTION MATERIALS

Sand of various types, gravel, colluvium and lateritic deposits have been exploited as a source of fill during construction of the North West Coastal Highway and the Dampier-Tom Price railway. Supplies of such materials are plentiful in the area. Precambrian rocks such as dolerite, gabbro and basalt could be utilized for ballast, aggregate and road metal.

COPPER

Several minor copper occurrences have been prospected in the past and a few tonnes of hand-picked oxidized ore raised. All occurrences are small quartz lenses or veins carrying limonite and secondary copper minerals which fill fractures in metamorphosed volcanic and sedimentary rocks. None of the occurrences shown on the map is of commercial importance.

Disseminated iron-copper-nickel sulphides have been found recently at several localities in the Mount Sholl-Radio Hill area. The mineralization occurs in metamorphosed gabbro-peridotite intrusions which commonly form bold hilly terrain. Visible expression of the mineralization is feeble and the main deposit at Mount Sholl is almost completely concealed.

GOLD

Gold workings indicated on the map are concentrated at the Upper Nickol centre (also referred to as "Radleys"). Most are shallow pits and all are abandoned, total recorded production being about 317 gm from 32 tonnes of ore. The principal mine at Radleys is approximately 20 m deep and has exploited a 0.5 to 1 m wide quartz vein through amphibolite schist. The size of the workings indicates that actual production probably exceeded that recorded. All the workings are centred on auriferous quartz veins intruding volcanic rocks.

Alluvial gold is currently being prospected at the Nickol Bay centre on the northeast margin of the sheet area but as yet there is no record of production.

NICKEL

Small deposits of massive to disseminated iron-nickel-copper sulphides have been discovered in the Ruth Well-Lailu Creek area. The mineralization occurs in lenses of metaperidotite emplaced in a metamorphosed sequence of mafic to ultramafic volcanic rocks. Surface expression of the mineralization is minor.

SEMI-PRECIOUS STONE

Bright green chert north of Edna Well has been excavated as a source of ornamental stone. Microscopic examination suggests that the colouration results from a chromium impurity.

WATER

Average annual rainfall in the area is about 300 mm, mainly falling as cyclonic rain between December and April. Rivers and creeks flow only briefly, after heavy rains.

Groundwater of domestic or good stock quality can be obtained over most of the mapped area. Most existing boreholes and wells are in alluvium along the Nickol and Maitland Rivers and their tributaries, or at the foot of long colluvial slopes. Small supplies are also obtained from fractured Archaean or Proterozoic bedrock.

Generally, the groundwater contains less than 4 500 mg/l Total Dissolved Solids (T.D.S.) and most is fresh enough for domestic use (less than 1 500 mg/l T.D.S.) in the upper parts of river catchments. The water table may be as much as 15 m below ground surface but is usually between 2 m and 10 m deep. Borehole and well yields rarely exceed 100 m³/day. Isolated, thick layers of impure limestone (calcrete) in alluvium, particularly upstream of constrictions in valleys, may yield supplies of as much as 250 m³/day.

As no large supplies of groundwater are available in the area, the Karratha light industrial area is supplied by pipeline from Millstream, some 100 km to the south.

ENGINEERING GEOLOGY

The engineering properties of rocks, which include such features as strength, suitability for foundations, stability on slopes and in excavations, and suitability as construction materials, depend on geological features such as mode of origin, composition, susceptibility to processes of change such as metamorphism, weathering and erosion, and their present mode of occurrence. The generalized engineering properties of the rocks that occur in the area are described with this in mind.

ARCHAEAN

A variable group of rocks with a wide range of engineering properties. The intrusive rocks of Archaean age are strong and stable when fresh, but near the surface are generally weakened and less stable due to weathering of either the rock or in joints. The schistose phases and sheared zones within these rocks are particularly susceptible to weathering.

Although the igneous parts of the basic and intermediate volcanic unit are resistant to erosion and crop out to form hills, a detailed examination shows many defects and complex variations in composition and structure. In addition to jointing the rocks are foliated in part, contain lenses of weak material and are cut by quartz veins and minor dykes of varied composition. These features may, but do not necessarily, make them unstable on slopes or in excavations or reduce their suitability as foundations but do detract from their value as a source of aggregate. Of the chert and clastic sediments, the more abundant clastic sediments are generally weak. They would not stand well in excavations but would be satisfactory as foundations for structures of moderate loading. Their properties differ widely from those of the interbedded chert which more commonly crops out and is hard and resistant to weathering. Engineering problems could arise with the rock unit as a whole because of the differing properties of the two closely associated rock types. For example, slopes and excavations could be unstable and differential settlement could occur beneath foundations. They are unsuitable as a source of aggregate.

The **ferruginous chert** unit is generally strong and forms ridges but contains well-developed bedding and joint surfaces which aid the production of abundant rock fragments in the colluvium that forms on the slopes. This contributes to the suitability of adjacent superficial deposits as a construction material. Because of this interbedded shales the rock unit as a whole has some of the engineering defects of the previous group, such as instability on slopes and in excavations, but the predominantly chert sections would make satisfactory foundations in flat areas even for high load structures.

PROTEROZOIC

The Proterozoic igneous rocks are generally more uniform and less deformed than the Archaean rocks and present fewer engineering problems. They are generally competent and unless extensively jointed or weathered are expected to have satisfactory engineering properties. In some cases these rocks produce scree slopes in the areas below prominent outcrops, for example, the quartz veins near the North West Coastal Highway and the basalt near Mount Sholl. Such scree material is unstable if close to its natural angle of rest, but could be a source of fill material for construction.

CAINOZOIC

Laterite is a rock with varying engineering properties depending on its state of erosion. It has been used as gravel for road construction purposes.

The Quaternary group includes a wide variety of superficial units with complex field relationships and differing engineering properties. For example, the behaviour of a unit is modified by such factors as the properties of an underlying unit, level and salinity of the local groundwater and the pH of the unit. Because this material occurs in the flatter parts of the area where future development is expected, its varying properties and their complex distribution are significant. It is stressed that detailed investigation at the actual site of proposed development is necessary and the information given here can only serve as a guide.

One of the major engineering problems with the silty sand unit is the presence of expansive clays in the clayey sand sub-unit. The expansive clays contain a high percentage of montmorillonite thought to be derived from the weathering of ferromagnesian minerals in the mafic and ultramafic volcanic and intrusive rocks of the region. If the material containing expansive clays is not avoided in the siting of engineering works, it should either be removed or allowed for in the design of foundations. This allowance can be made by placing a foundation pad of stable material over it or by taking foundations below the surface zone of fluctuating moisture content. Both methods have been used in the area.

Low permeabilities occur in the clayey parts of the silty sand, and in the colluvium and outwash soils with high pH values. In these latter soils the clays disperse when wet, further reducing permeability. These types of soils should be avoided for housing development, or precautions taken, such as provision of adequate drainage. In these areas, the construction of foundation pads aids the solution of both drainage and foundation problems.

These types of soils also pose problems for road and railway construction both as foundations and when used for construction. They should therefore be avoided where possible or allowances made in design. Inadequate culverts behind embankments made of these materials allow ponding and consequent wetting which can lead to failure.

It may be necessary to take steps to prevent erosion from surface run off on embankments and where culverts discharge in areas of susceptible soils.

The less clayey parts of the superficial units such as outwash gravel, colluvium and alluvium make suitable foundations for structures of moderate loading provided the normal precautions are taken. Piles are needed for bridges where the major roads cross rivers filled with alluvium. For example, at the Nickol River, piles were driven through about one metre of gravel and one to two metres into the underlying rock.

The less clayey superficial units provide suitable fill material for the construction of foundations. The coarser alluvial gravels are suitable, after treatment, for concrete aggregate. Such deposits from the Maitland River west of this area are currently being used for this purpose, but similar deposits occur in this area.

In many cases the superficial **deposits are** thin or of too limited extent to have any engineering **significance**.

ENVIRONMENTAL GEOLOGY

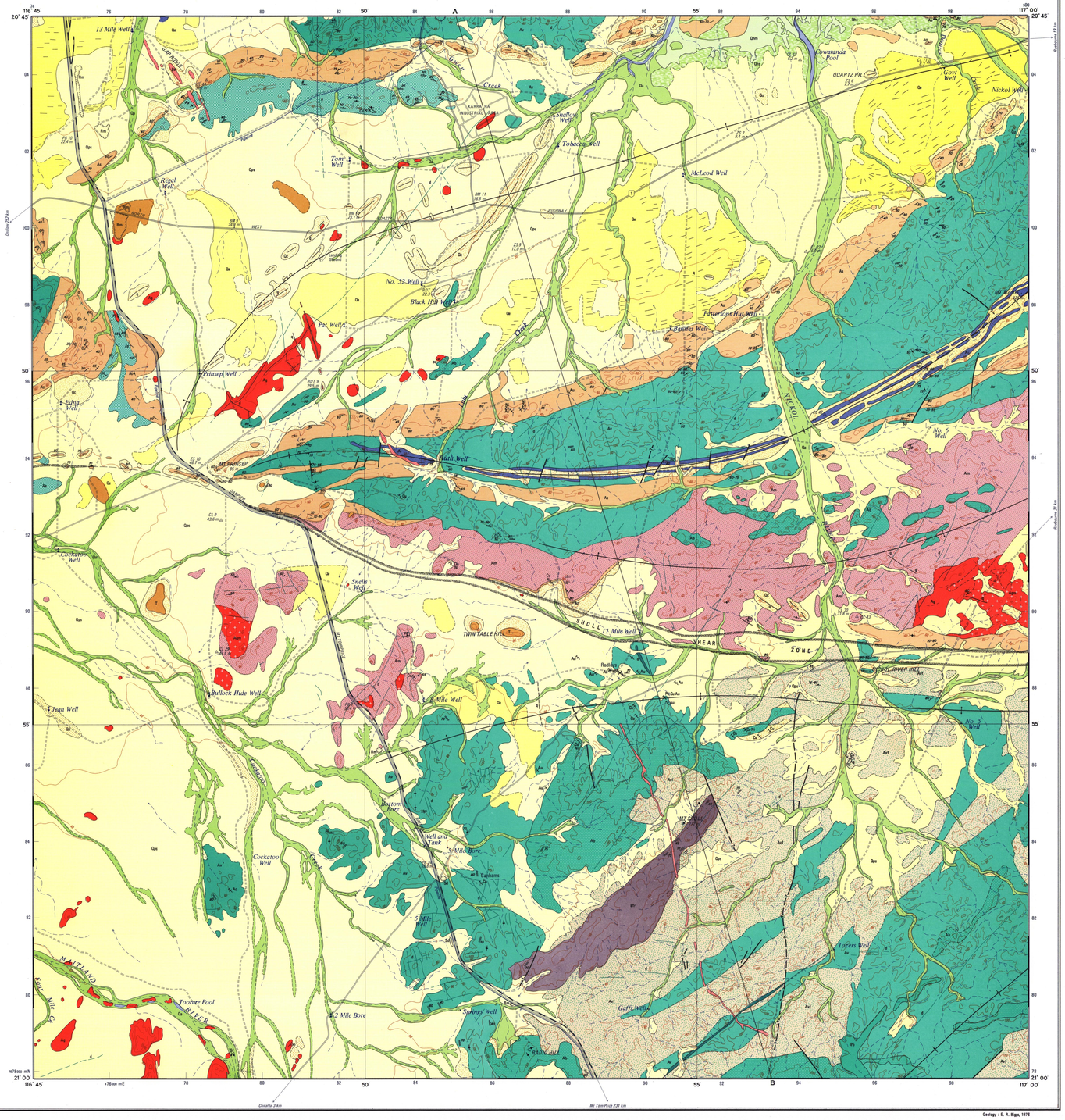
The fine silt fraction of the plain sediments inhibits free flushing of groundwater and this has probably contributed greatly to the retention of salts in the soil profile. Excessive irrigation may remobilize these salts and cause salt-scalding down-slope from the irrigated area unless adequate drainage is provided. This problem would be more pronounced in the eolian and clayey sands but also applies to the silty sand units.

Excavated waste disposal sites near the Karratha light industrial area should be readily available away from major creeks as the silty sand plain averages ten or more metres in depth. Many wells exploit an aquifer at about 10 m, however, so careful siting is needed relative to drainage directions to avoid water supply pollution. Liquid waste disposal will need even more careful planning but sites should still be readily available. Exhausted "gravel" pits in colluvium would provide suitable disposal sites for dry or wet waste in most areas. Toxic waste could probably be safely stored in many of the hard rock areas if provided with adequate sealants and safeguards to prevent groundwater contamination.

Several small gravel pits have been opened alongside roads and tracks. In future, consideration should be given to siting such pits less conspicuously and perhaps as larger units to avoid waste of resources by piecemeal extraction. Provision should also be made for adequate drainage to avoid the results seen in some pits after rain. As the soil horizon has been removed, rainwater cannot soak in and runs through the pit carrying a heavy load of silt which is discharged on level ground outside the pit. If that level ground is a road or track, considerable inconvenience and removal costs can result. The silt-laden water may also be an agent for gully erosion.

Soil erosion is generally a minor problem within the sheet area, partly due to the gentle slopes on the red soil plains. Sheet flooding, especially in the Maitland valley, probably removes some millimetres of soil each wet season but the bulk is redeposited within the valley.

Further information may be obtained from the Geological Survey of Western Australia in Perth.



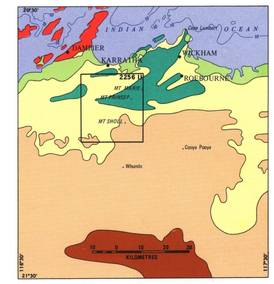
REFERENCE

		MAXIMUM THICKNESS (m)	
CAINOZOIC	QUATERNARY	HOLOCENE	Qhm	? 5	Mud and silt
			Qhs	? 3	Silty sand, red–brown, containing *Anadara Granosa* (intertidal and estuarine) lateral views of right valve
			Qa	8	Alluvium; gravel, sand or silt
			Qc	10	Colluvium; mainly quartzose scree
			Qo	0.1	Outwash gravel veneer on Qps
		PLEISTOCENE TO HOLOCENE	Qe	3	Eolian and clayey sands
			Qps	? 15	Silty sand, red–brown
	TERTIARY	PLIOCENE	T	20	Laterite, massive or rubbly, with pallid zone
PROTEROZOIC	?			50	Dolerite dyke
			Pp	50	Granophyric xenolithic dyke
			Rh	100	**MOUNT ROE BASALT**
			Rb	? 250	Gabbro and dolerite sill and dyke
				40	Quartz vein
ARCHAEAN			Ai	200	Ferruginous chert, chert, jaspilite, shale and siltstone
			Ab	? 300	Gabbro and dolerite intrusions, metamorphosed
			Av	1300	Basic and intermediate volcanics, minor metasediments
			As	1000	Cherts and clastic sediments
			Avf	3000 +	Felsic volcanics
			Aa	500 +	Amphibolites, massive and schistose
			Agm	?	Hybridized basic rocks and granite
			Ag	?	Granite and granite gneiss
			Am	1000 +	Undifferentiated metamorphosed intrusive complex

SYMBOLS

- Geological boundary: Accurate; Inferred or transitional; Unconformable
- Fault: Accurate; Inferred
- Sholl Shear Zone: Accurate; Inferred
- Bedding: Strike and dip; Strike of vertical beds; Strike and dip of base; Strike of vertical lens
- Foliation: Strike and dip; Strike of vertical foliation
- Strike of vertical jointing
- Strike and dip of vein or dyke
- Dune trend
- Axis of syncline
- Axis of anticline
- Quarry or pit
- Alluvial working
- Abandoned mine
- Prospect
- Mineral occurrence: Arsenic As; Asbestos As; Chert, semi–precious Ch; Copper Cu; Gold Au; Gravel Gr; Lead Pb; Nickel Ni; Road material Rm; Sand Sd; Silver Ag; Zinc Zn
- Highway (1)
- Major road
- Minor road
- Track
- Railway
- Townsite boundary
- Horizontal control; major, minor
- Benchmark, height accurate (AGT 12, 27.2 m)
- Contour in metres
- Watercourse
- Pipeline
- Windpump on well or bore

The representation on this map of a track does not necessarily imply right of way



PHYSIOGRAPHIC DIAGRAM

- Dampier Archipelago
- Coastal Flats
- Coastal Plain
- Isolated Hills
- Dissected Uplands
- Chichester Range Plateau

DECLINATION DIAGRAM

The lines indicate magnetic declination, 1975.
+ means declination is east and correction must be added to compass bearing to give true bearing.
– means declination is west and correction must be subtracted from compass bearing to give true bearing.
Annual change is –1° westerly

INDEX TO ADJOINING SHEETS

DAMPIER 2256 IV	NICKOL BAY 2256 I	POINT SAMSON 2356 IV
BAYNTON 2256 III	KARRATHA 2256 II	ROEBOURNE 2356 III
MOONDLE 2255 IV	PINDERI HILLS 2255 I	HARDING 2355 IV

RELIABILITY DIAGRAM

A : Numerous traverses
B : Few traverses
Both with air photo interpretation and reference to earlier mapping notes

HON. A. MENSAROS, M.L.A.
MINISTER FOR MINES
J. H. LORD, DIRECTOR, GEOLOGICAL SURVEY

SCALE 1:50 000

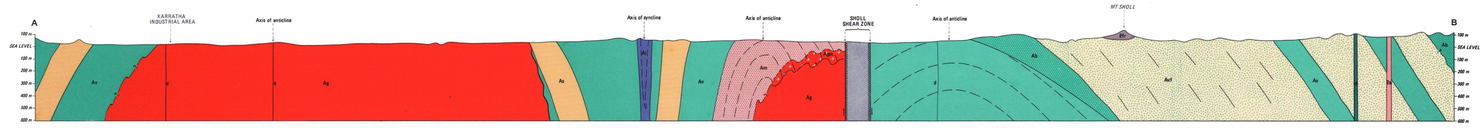
KILOMETRES 1 0 1 2 3 4 5 6

CONTOUR INTERVAL 0–100 m: 20 m; Over 100 m: 50 m

Ticks inside the sheet edge represent 2000 metre intervals of the superimposed Australian Map Grid, Zone 50 AUSTRALIAN NATIONAL SPHEROID

DIAGRAMMATIC SECTION A-B

SCALE V/H = 2.5



Compiled and published by Geological Survey of Western Australia. Cartography by Geological Mapping Section, Department of Mines. Topographic base from compilations by Department of Lands and Surveys. Printed by Government Printing Office, Perth, 1979.

Copies of this map may be obtained from the Geological Survey of Western Australia, in Perth.

Geology : E. R. Biggs, 1976

KARRATHA
URBAN GEOLOGY
2256 II
Crown Copyright Reserved
FIRST EDITION 1979